REMARKS

Amendments to the Claims

Applicants respectfully submit that the amendments to the claims find support in the application as originally filed. Specifically, support is found in Paragraphs 54 - 58, as well as FIG. 5. Therefore, Applicants respectfully submit that no new matter has been introduced by the amendments to the claims and that the claims are currently in condition for allowance.

Claim Rejections – 35 U.S.C. §103

Claims 1 and 3 – 34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over McCollum (5,789,764) in view of Takagi et al. (5,550,400), Shan (6,906,421), Liu ("A New Metal-to-Metal Antifuse with Amorphous Carbon," IEEE Electron Device Letters, Vol. 19, No. 9 (1998), pp. 317 – 319), and Forouhi (5,181,096).

For a §103 obviousness rejection to be proper, the Examiner must meet the burden of establishing that all elements of the invention are disclosed in the prior art; that the prior art relied upon, coupled with knowledge generally available in the art at the time of the invention, must contain some suggestion or incentive that would have motivated the skilled artisan to modify a reference or combined references; and that the proposed modification of the prior art must have had a reasonable expectation of success, determined from the vantage point of the skilled artisan at the time the invention was made. MPEP 2143.

Claim 1, which has been amended, recites a "reprogrammable metal-to-metal antifuse . . . programmed in response to a programming potential applied across the antifuse; and . . . erased in response to an erasing potential, lower in magnitude than the programming potential." None of the references cited by the Examiner teach or suggest

a reprogrammable antifuse programmed and erased as claimed. As stated in the specification, a "characteristic that is common to prior-art antifuses is that they have typically been only one-time programmable, that is that the programming mechanism that creates the low-resistance connection between the two antifuse electrodes has been irreversible." *Specification* ¶ 0018. Unintended switching (read-disturb) behavior has been known in prior art antifuses, but as described in McCollum, these disturbs are regarded as a problem to be solved as they are unintended and uncontrolled, and can generate errors. *See McCollum*, col. 1, lines 57-67. Furthermore, unlike a reprogrammable antifuse that has been erased, the accidentally disturbed antifuses described in McCollum did not return to a low leakage, high voltage unprogrammed state, instead resulting in an undesired off state that had an indeterminate state, neither really off nor really on, and easily susceptible to further disturbs. Disturbed prior art antifuse devices also cannot be reprogrammed in a controlled fashion. "Controllable [erasing and] reprogramming of antifuses has been an elusive goal." *Specification* ¶ 0018.

Applicant respectfully submits that McCollum, Takagi, Liu, Forouhi, and Shan, alone or in combination, fail to teach or suggest an erasable or reprogrammable metal-to-metal antifuse. The Examiner states that "Forbes [(6,674,667)] teaches a method for programming and erasing a reprogrammable metal-to-metal antifuse." *Office Action* (mailed 4 Dec. 2006) at 8. Applicant respectfully submits that while Forbes has labeled his invention as a "programmable fuse and antifuse," this is a reference to the MOSFET disclosed in Forbes performing a logical function traditionally performed by a fuse or antifuse (e.g., operating as a non-volatile, normally-open or normally-closed programmable element). Applicant respectfully submits that one skilled in the art would not consider the term "metal-to-metal antifuse" to include a field-effect transistor, the

programmable element disclosed in Forbes. Although Forbes describes a field-effect transistor as performing the logical function of a fuse or antifuse, field effect transistors have very different structures and operate on different physical principles from metal-to-metal antifuses. By way of example, the Examiner cites Figure 6 of Forbes, which shows steps of grounding source and drain regions and operating a metal oxide semiconductor field effect transistor ("MOSFET"). A metal-to-metal antifuse structure is not a transistor, and thus does not have source and drain regions. Applicant respectfully submits that Forbes does not teach or suggest a metal-to-metal antifuse, let alone a reprogrammable metal-to-metal antifuse.

The Examiner states that "McCollum teaches in figure 7C and related text a reprogrammable metal-to-metal antifuse." *Id.* at 2. The Examiner, however, provides no support for the claim that McCollum teaches a reprogrammable antifuse. Applicants respectfully submit that McCollum does not teach or suggest a reprogrammable antifuse. The Examiner also states that McCollum teaches upper and lower adhesion layers as recited in claim 1 by disclosing barrier metal layers 90 and 94 in figure 7C and related text. Applicants respectfully submit that barrier metal layers in the amorphous silicon antifuse of McCollum do not teach or suggest the use and type of adhesion layers in a reprogrammable amorphous carbon metal-to-metal antifuse, as recited in claim 1. In fact, claim 1 recites upper and lower adhesion layers *in addition to* Ti barrier layers.

The Examiner argues that applicants' claimed reprogrammable metal-to-metal antifuse including barrier layers, adhesion layers, and an amorphous carbon layer is obvious in view of various references that disclose antifuses including barrier layers and silicon carbide or silicon nitride layers. The Examiner argues that, although these references do not disclose a reprogrammable metal-to-metal antifuse as claimed, and more specifically do not disclose an antifuse employing amorphous carbon as an antifuse

material with adhesion layers and barrier metal layers as claimed, "substitution of materials is not patentable even when the substitution is new and useful" citing *Safetran Systems Corp. v. Federal Sign & Signal Corp.* (N.D. Ill. 1981) for this proposition.

Applicants respectfully submit that the Examiner's argument suffers from a number of flaws. Applicants have not been able to find a single federal case that cites to *Safetran* as authority. The *Safetran* case cites to *Centsable Products, Inc. v. Lemelson*, 591 F.2d 400, 403, 201 USPQ 655, (7th Cir.), *cert. denied*, 444 U.S. 840, 203 USPQ 650 (1979) for the proposition that substitution of materials is not patentable even when the substitution is new and useful in holding that a railroad gate arm composed of fiberglass instead of wood is not patentable. *Safetran* at 984. What *Centsable* actually states is that the "*general rule* is that substitution of materials is not invention, even when the substitution is new and useful." *Centsable* at 403 (citing 2 *Deller's Walker on Patents*, § 112 (2d ed. 1964)) (emphasis added). In holding that the substitution of prior art Velcro for the naturally occurring cocklebur used in a prior art dart game was not patentable, the *Centsable* court went on to explain:

> Lemelson suggests that to hold his patent invalid would be tantamount to holding that mere substitution of existing materials is never patentable. We are cognizant that a mere combination of elements can lead to a patentable item if the result is sufficiently new and useful. *Ekstrom-Carlson & Co. v. Onsrud Machine Works, Inc.*, 298 F.2d 765, 770 (7th Cir. 1962). Here, however, the substitution or combination of elements was obvious because of the previously discussed patents and articles. The similar games developed before or contemporaneously with Lemelson's are further evidence that the combination was obvious.

Applicants respectfully submit that the reprogrammable metal-to-metal antifuse employing amorphous carbon recited in claim 1 is a new and non-obvious structure and not a mere "substitution of materials." Applicant respectfully submits that use of barrier metals does not teach use of adhesion layers, and that use of adhesion layers to adhere

between materials *other than* amorphous carbon and barrier metals does not teach or suggest use of adhesion layers to adhere between amorphous carbon and barrier metals. The scale and precision of semiconductor design and manufacturing make material selection and combination very important and material properties less predictable than in the mechanical fields at issue in the *Safetran* and *Centsable* cases. The long-standing need for an antifuse that is reprogrammable, rather than one-time-programmable only, indicates that applicants' claimed structure, including the arrangement of materials recited, is new, useful, and non-obvious.

Applicants respectfully submit that the remarks above apply equally to claims 1 and 3 – 34, which all claim reprogrammable metal-to-metal antifuses employing antifuse layers that include amorphous carbon.

Claims 40 and 42 - 46 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Forbes. As discussed above, Forbes fails to disclose a metal-to-metal reprogrammable antifuse and therefore also fails to teach or suggest a method of programming and erasing a metal-to-metal reprogrammable antifuse.

Applicants respectfully submit that all claims are currently in condition for allowance. A Notice of Allowance is earnestly solicited.

Respectfully submitted,

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